PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS
The Patent Office

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

BEST AVAILABLE COPY

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 2 August 2004

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

10APR03 E799274-1 D10007
P01/7700 0.00-0308258.3

THE PATENT OFFICE
C
10 APR 2003
NEWPORT

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference — P3162 GB PRO

10 APR 2003

2. Patent application number *(The Patent Office will fill in this part)* — 0308258.3

3. Full name, address and postcode of the or of each applicant *(underline all surnames)* — 'The Central Science Laboratory', "CSL", Representing the Secretary of State for Environment, Food and Rural Affairs
Sand Hutton, YORK, YO41 1LZ
United Kingdom

Patents ADP number *(if you know it)* — 8478364001

If the applicant is a corporate body, give the country/state of its incorporation — UK

4. Title of the invention — MARKING SYSTEM AND METHOD

5. Name of your agent *(if you have one)* — NOVAGRAAF PATENTS LIMITED

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)* — THE CRESCENT
54 BLOSSOM STREET
YORK YO24 1AP

Patents ADP number *(if you know it)* — 08299166001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	12
Claim(s)	
Abstract	
Drawing(s)	1 + 1 RM

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 09/04/2003

NOVAGRAAF PATENTS LIMITED

12. Name and daytime telephone number of person to contact in the United Kingdom: PETER WILSON (DR) 01904 610586

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

MARKING SYSTEM AND METHOD

The invention relates to a marking system and method to facilitate the identification, authentication and quality control of packaged products, particularly but not restricted to food and food products and other similar organic products of complex composition. The invention is also a packaged product carrying such a marking for use in such a system and/or in accordance with such a method.

The invention relates to packaged products which are typically placed in containers (which term is intended to encompass containers of any suitable type) at a manufacturing or distribution centre for onward shipping to a remote site for use, storage, consumption, sale etc.

There is a well understood general desire to be able to monitor and track such a product at stages in the fabrication and distribution process, particularly where this is a food or food product, other product intended for human or animal consumption, or other product where close monitoring of the chemical composition might be critical. In particular the need might arise for subsequent testing of samples from a batch of packaged products at a point down the distribution line.

Such a need might arise for example for authentication purposes, for example to check that a product is original (or at least is of original quality, and not an inferior counterfeit) in the case of branded products, products of protected denomination of origin and the like; or quality control to ensure that a product meets a quality, safety or other composition specification standard; or to check and detect whether a product has been adulterated; or to check and monitor

degradation of quality over time, by ensuring composition remains within a predetermined satisfactory range; or for various other purposes.

Various analytical techniques exist to determine the overall chemical composition and/or the concentrations of particular target chemical species in such a product. It is possible to carry out such analysis on representative samples taken from a batch of previously packaged products, and to make a comparison either with standard reference or predetermined specification data or with data collected from that batch of product prior to packaging. An assessment can be made then of whether the composition of a sampled product meets such predetermined parameters for the purposes discussed above. This requires careful maintenance of a paper trail or other data record referring back to the point of packaging to ensure that subsequent batch sampling is matched with data relating to the product at packaging, which for complex production and distribution networks can become cumbersome, inefficient and slow.

There is a general desire to provide an authentication system for identification, authentication and quality control of packaged products, which can be carried out by screening samples from batches of packaged products themselves without the need for such complex cross-referencing.

In accordance with the present invention in a first aspect in its most comprehensive concept the invention comprises a methodology for facilitating the identification, authentication or quality control of packaged products, which methodology comprises:

in a first marking phase:

obtaining data representative of aspects of a predetermined desired chemical composition for the product;

processing and digitising the data;

recording the digitised data on a machine readable data storage means provided in association with the packaged product, in particular in direct mechanical association with the packaging thereof, and for example being incorporated into or onto or as a part of such packaging;

and in a second authentication step:

applying a suitable data reader to the data storage means to read the recorded data;

chemically analysing a sample of the product to obtain data representative of aspects of the actual chemical composition for the product;

comparing the results of the said analysis with the recorded readings within predetermined tolerance limits.

Making this comparison allows an assessment to be made of measured analytical data from a sample taken from a packaged product against reference data contained in or on or in direct association with the package. It is not necessary to refer back in any way to other sources of information. A rapid assessment of whether the composition of the packaged product is within tolerance limits of a desired composition range can be made, for example to check its authenticity, to check its quality, to ensure it has not been adulterated or has otherwise degraded etc., can be carried out with reference to the packaged product alone. A simple, rapid and automatic screening system for such products is therefore provided.

The machine readable recorded data comprises an indication of an expected result for the subsequent chemical analysis step. If this expected result corresponds, within predetermined tolerance limits, to the measured result when a sample is subsequently taken, a batch so tested may be passed. If the comparison reveals that the measured result is outside such tolerance limits,

the batch may be rejected and/or passed on for more detailed analysis or other further processing.

It will be apparent that this reference data could be obtained in a number of ways. Reference data might be representative of established composition parameters from established limits or specifications. Reference data might include compositional information obtained from periodic testing of the product to be packaged. This may be irregular representative testing, or specific testing of each batch, such that the recorded reference data corresponds to analysis data specific for the product within a particular package. Reference data may include combinations of the foregoing.

In a particular preferred embodiment the reference data is obtained by testing of a representative sample for each product or batch of products at the time of packaging. Thus, in the preferred embodiment, the marking phase of the methodology is modified to comprise the step of analysing a sample of the product, prior to or during packaging, to obtain reference data representative of aspects of a predetermined desired chemical composition for the product. Accordingly, the authentication phase of the methodology is preferably modified to comprise the step of repeating the chemical analysis of the above marking phase to obtain data representative of aspects of the actual chemical composition for the product.

It will be understood that the overall methodology includes a marking phase and an authentication phase which are likely to be carried out remotely from each other in space and time, and independently. Accordingly, the invention in a further aspect comprises a marking method to facilitate the identification authentication or quality control of packaged products, and in a yet further aspect comprises an authentication method for the identification,

authentication or quality control of packaged products marked in accordance with the foregoing, the respective aspects of the invention comprising the marking phase and authentication phase as above described performed independently.

The analysis method comprises any known method of chemical analysis suitable for obtaining data representative of the composition, or aspects thereof, of the product in question. Particularly preferred are analysis methods which generate data that can be easily processed, digitised and stored. It is desirable for the analysis method to be repeatable, and to be relatively independent of test conditions, to ensure consistency of results regardless of where the test is performed, and hence accuracy of comparison of analysis data with reference data when the analysis step is carried out by a number of different users at a number of remote sites.

In a preferred embodiment, nuclear magnetic resonance is used for the analysis step during the authentication phase. More preferably, nuclear magnetic resonance is also used to provide an analysis of the sample to create reference data during the marking phase.

The invention relies on the creation of reference data that is then recorded in machine readable form in direct association with the packaging. In the preferred embodiment, this reference data is obtained by batch analysis of the product to be packaged, for example during manufacture or otherwise prior to or during packaging. The reference data may optionally further include additional compositional data derived from standards, reference specifications, predetermined tolerance parameters and the like.

The reference data produced by this analysis step and/ or obtained otherwise from reference or specification sources is collected and digitised to convert raw chemical composition data into a recordable, readable and processable form. In particular, this stage might be carried out under the control of suitable computer software or a suitably programmed computer, for example comprising the steps of collecting raw analysis data and/ or reference data from reference or specification sources, digitising the data, transferring the digitised data to the input of a suitable data processor, processing the data as described and outputting the processed data in a form suitable to be recorded on the data storage means and/or to provide a set of instructions for the fabrication of a data storage means such that the data is readable thereon.

The data storage means serves as a record of the reference data. It provides a machine readable digital data source in direct association with the packaged product to avoid the need for an extensive paper trail and to ensure that a simple testing and screening process can be carried out with reference to the packaged product alone and without reference to extraneous information sources.

A range of potentially suitable data storage means will suggest themselves, and will include optically, electronically and magnetically readable devices and/or areas on or comprised as part of the packaging. Suitable reference data storage means might include magnetic strips, smart chips etc., and optically readable areas, in particular in a preferred embodiment comprising optical areas of light and dark markings and/or colour and/or grey shade markings in one or two dimensions, such as bar codes or the like.

For many applications, bar codes will be particularly preferred. Bar codes and bar code readers are familiar in relation to packaged food and similar products,

which should facilitate use of the system in accordance with the invention. Moreover, in relation to the preferred analysis method using a NMR spectrum, data transfers particularly effectively to a linear grey-scale bar code, which is accordingly especially preferred.

A simple linear barcode or other optically readable structure may be used. Alternatively, a plurality of barcodes or other structures may be provided for example to give measurement of different compositional aspects and/ or of expected compositions varying with time in store, to give a representation of shelf life or similar. More complex optically readable structures, for example comprising multiple sub-structures and/or having two-dimensional extent can be considered to give more information.

The reference data may be stored on the data storage means in directly readable form, or in an encrypted or otherwise secure form.

In the authentication phase, the reference data is read by a suitable reader, which depending on the data storage means might include a magnetic strip scanner, a smart chip reader, an optical data reader such as a bar code reader or the like. As has been noted, optical readers such as bar code readers are particularly preferred, being simple and effective, and being systems which are already familiar in relation to packaged products of this type.

An analysis step is carried out using a suitable chemical analysis method, such as NMR. The reference data has been created with reference to this analysis step, and in particular has been created by the previous carrying out of an equivalent analysis step on a sample of the packaged product. A comparison is then made of the results of the analysis to the predetermined reference data within predetermined tolerances. This comparison step in particular is carried

out automatically by an analysis system, for example by passing analysis data to a comparator, which conveniently comprises the processor of a suitably programmed computer, making the comparison, and outputting the results in an operator readable form. In an optional further step, the result is displayed, for example by visual and/or audio visual display means.

Comparison is made within predetermined tolerance limits, for example to judge quality or acceptability on a pass/fail basis. These tolerance limits may be stored as part of the reference data, may be prerecorded within the comparator, or may be input by or otherwise applied by a user at the comparison stage. The reference data may include a series of tolerance limits and/or a plurality of reference composition ranges corresponding for example to different levels of product degradation, so that the system can give an indication of shelf life or similar.

In accordance with a further aspect of the invention a system for the identification, authentication and quality control of packaged products comprises:

a machine readable data storage means provided in association with the packaged product, in particular in direct mechanical association with the packaging thereof, and for example being incorporated into or onto or as a part of such packaging;

a marking device for processing digitised data representative of aspects of a predetermined desired chemical composition for the product and recording the digitised data on the data storage means in readable form;

an authentication device comprising a suitable data reader to read the recorded data on the data storage means;

a chemical analyser to analyse a sample of the product to obtain data representative of aspects of the actual chemical composition for the product;

a means to compare the results of the said analysis with the recorded readings within predetermined tolerance limits.

As before, it will be understood that the marking and authentication processes are likely to be carried out remotely from each other in space and time, and independently. Accordingly, the invention in a further aspect comprises a marking system as above described to facilitate the identification authentication or quality control of packaged products, and in a yet further aspect comprises an authentication system as above described for the identification, authentication or quality control of packaged products marked in accordance with the foregoing.

Preferably, the marking system will be provided in association with a chemical analyser, conveniently to carry out an identical analysis to that carried out by the authentication system, to analyse a sample of the product to obtain data representative of aspects of the chemical composition for the product prior to or during packaging, and data processing means to collect and digitise the data and convert to a reference mark for application by the marking system.

Optionally, the authentication system includes display means to display a result to a user. This may take the form of an alphanumeric display, coloured lights, sounds and alarms etc. in any suitable combination. Since the system is primarily intended as a screen it will often be sufficient that the display is adapted to display one of a small number of discreet results, and in particular to display a pass/fail result.

In accordance with a further aspect of the invention, a marked packaged product to facilitate identification, authentication and quality control of the contents thereof comprises a product retained within a container and having

associated therewith, in particular in direct physical association with the container and for example on or comprising a part thereof, a machine readable reference mark incorporating prerecorded data indicative of the expected chemical composition of the product, and in particular prerecorded data relating to the chemical composition of a batch sample associated with the product.

The invention is applicable to any contained chemical product where there might be a desire to track composition and detect changes in composition for any of the reasons set out herein above, for example in relation to concerns about authenticity, maintenance of quality specifications, adulteration, degradation over time etc. The invention is particularly applicable to food, food products and the like. It is also suited to other products for human or animal consumption or use where similar safety issues arise, such as pharmaceutical and cosmetic products. It is also suited for use with other products where similar quality control and specification issues arise, such as fine chemical and agrochemical liquids.

References herein above to packaged products cover any such products when placed in any suitable containers for onward distribution or storage and the like, including consumer products in bottles, cartons, jars, packets, sachets etc., and contained products contained for storage or shipping on a larger scales in barrels, vats, tanks etc.

In all such cases, the present invention provides a convenient and effective means to batch sample and screen remotely distributed or stored packaged products themselves by virtue of information stored in direct association with the packaged product and without requiring reference to any extraneous information sources.

The invention will now be described by way of example only with reference to Figure 1 of the accompanying drawing, which illustrates an example of a bar code marking suitable to be incorporated into the packaging of a packaged product to put the foregoing invention into practice.

Figure 1 illustrates an NMR barcode generated as a greyscale projection of a 1D 1 H NMR spectrum. The depth of colour is directly proportional to the peak intensities of the NMR spectrum, so by scanning the barcode the NMR spectrum can easily be reconstituted. The NMR barcode is representative of reference data for the product, and is most conveniently obtained by NMR analysis of a sample of product before or during packaging, using conventional NMR apparatus.

By associating this barcode with a target product, such as a protected denomination of origin or branded product, perhaps as part of the packaging, it would be relatively straightforward to confirm that what is in the packet produces the same NMR profile as that defined by this barcode. This can be done by repeating the NMR analysis of a sample of packaged product using conventional NMR apparatus for example at a remote site.

The actual result is compared with the expected result provided by the barcode in direct association with the product to ensure correspondence within reasonable tolerances. It becomes possible simply and quickly and without external reference for example to check that a product is original (or at least is of original quality), to ensure that a product meets a quality, safety or other composition specification standard or to check and detect whether a product has been adulterated.

Another possible use is to confirm the age of a product. Multiple NMR spectra of a perishable product can easily be stored as a barcode with a similar depth as the one above. By matching the profile of the product inside the packaging to a time course of expected profiles from a particular product it should be possible to estimate the approximate age of the product.